

# A High-Efficiency Method for Direct Bonding of SiC to Si via Atmosphere Inductively Coupled Plasma

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*The SiC/Si heterostructure is pivotal in various applications owing to its superior performance and potential for advanced electronic and optoelectronic devices. A direct bonding method utilizing plasma to activate surface in a vacuum environment has been developed for SiC/Si heterogeneous integration. The necessity of a vacuum environment reduces the efficiency of plasma activation bonding (PAB), thus limiting its application in heterogeneous integration. In this study, we investigated the high-efficiency and low-temperature direct bonding of SiC/Si via atmosphere inductively coupled plasma (ICP). Following less than 5 s of Ar ICP irradiation, surface activation was achieved, resulting in the formation of a superhydrophilic surface (contact angle < 3°). The surface maintained the roughness and flatness that met the requirements for direct bonding during ICP irradiation. Additionally, ICP irradiation effectively eliminated surface contaminants and enhanced the quality of direct bonding. After low-temperature annealing, the bonding strength reached 4.38 MPa. The results show that ICP irradiation can efficiently activate the surface and improve the bonding quality without a vacuum environment. The direct bonding of SiC/Si heterostructures through ICP irradiation holds significant potential for the fabrication of high-performance power electronics and micro/nanofluidic devices.*

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